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Stock definition of belugas and narwhals in Nunavut

Définition des stocks de bélugas et narvals du Nunavut

P. R. Richard

Fisheries and Oceans Canada / Pêches et des Océans Canada
501 University Crescent / 501 Université Crescent
Winnipeg, MB
R3T 2N6

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ABSTRACT

This document provides information relevant to the definition of stocks of belugas and narwhals in Nunavut in response to a request from the Nunavut Wildlife Management Board. There is good evidence of seasonal geographic segregation between Nunavut beluga stocks, and even year-round in many cases. There is also good evidence of genetic, contaminant and morphological differences between many of them. Evidence for narwhal segregation between stocks is largely from tracking data, although some genetic and contaminant also hints at some degree of geographical partitioning. For hunting communities that rely on a predictable seasonal occurrence of animals for their subsistence, reducing chances of local depletion by hunting multiple stocks as suggested by present information is an appropriate approach to co-management.

RÉSUMÉ

Ce document présente de l'information pertinente à la définition des stocks de bélugas et narvals du Nunavut, en réponse à une demande d'avis scientifique du Conseil de gestion des ressources fauniques du Nunavut. Il existe de bonnes sources d'information portant sur la ségrégation géographique saisonnière et, dans bien des cas, annuelle des stocks de bélugas du Nunavut. Des résultats probants sur leur génétique, leurs niveaux de contaminants et leur morphologie supportent aussi ces conclusions. Chez les narvals, ce sont largement des résultats de suivis télémétriques qui supportent les conclusions relatives à la ségrégation saisonnière des stocks. Il y a aussi des données sur leur génétique et leurs niveaux de contaminants qui suggèrent des différences dans la répartition géographique de certains stocks. Pour des communautés de chasseurs qui comptent sur une présence saisonnière prévisible de ces espèces, l'approche de cogestion appropriée pour réduire des risques de surexploitation locale est de définir autant de stocks que sont suggérés par l'information disponible.

INTRODUCTION

The Nunavut Wildlife Management Board (NWMB), in its review of advice provided by Fisheries and Oceans Canada (DFO) Science on Total Allowable Harvest (TAH) for Nunavut beluga and narwhal stocks, has asked DFO to provide clarification on its rationale for providing science advice on the basis of known summering stock aggregations rather than at the population level. The NWMB also asked for clarification about various terms used (e.g., population, stock, sub-stock, management unit) and for an update on the current stock identity of belugas harvested by hunters from Iqaluit and Kimmirut.

DISCUSSION

POPULATION TERMS USED FOR PROVISION OF ADVICE

Stock is a concept used variously in fisheries assessment but it generally refers to a resource unit, a group of animals that are subject to hunting removals (Stewart 2008). That means the age and sex classes of a population or mixed populations that are the valued target of the hunt.

The biological definition of a population is a reproductively isolated group of animals (Waples 1991). A "population" can also be a "stock" (a group of animals of interest) if it is reproductively isolated from other stocks.

Factors such as demographic and life history variability, habitat patchiness, environmental change, genetic sub-structuring and adaptability may result in temporally or spatially structured populations (Cope and Punt 2009). It is possible to have localized depletions or extinctions if this is not considered when harvesting occurs. It is therefore important to choose the definition of stock to suit the management goal. Avoiding local depletion is one such goal, particularly for hunting communities that rely on a predictable seasonal occurrence of animals for their subsistence. It is also promotes the conservation of genetic diversity which may result from adaptation to local conditions.

The term "sub-stock" was used by the Scientific Working Group of the Joint Commission on Conservation and Management of Narwhal and Beluga (JCNB) and the North Atlantic Marine Mammal Commission (NAMMCO) in the context of subdividing the widely accepted "Baffin Bay Narwhal" stock (SWG-JCNB 2005). This term was introduced in a conceptual model that proposed to sub-divide the previously defined Baffin Bay narwhal "stock" into smaller management units, given there was evidence that that overall stock might be composed of seasonally spatially discrete populations, which had annual site-fidelity to their summering ranges.

This review refers only to management "stocks", keeping in mind that some of these stocks may or may not be "populations" in the biological sense. Reference to "sub-stocks" in previous documents should be interpreted as meaning "stocks".

APPROACHES USED FOR STOCK DEFINITION

Stock definition of beluga and narwhal populations in Nunavut was derived from various sources of information:

1) studies of the seasonal range of the species in Nunavut and adjacent waters by documenting local and written reports of their occurrence,
2) appearance and behavioural differences of animals from different areas of Nunavut and adjacent waters,
3) studies of genetic and contaminant differences of animals from different parts of Nunavut and adjacent waters, and
4) tracking animals, using satellite-linked transmitters, to estimate their seasonal range and delimit areas of aggregations.

The combination of these data has allowed DFO and partners to identify six beluga stocks and five narwhal stocks in Nunavut, as well as several others in Nunavik, Greenland or Alaska. These are considered provisional management stocks in the sense that any new information that may inform these conclusions would be taken into consideration to revise the list if needed.

The use of summering stocks as management units is considered precautionary. As mentioned above, it is possible to have localized depletions or extinctions if this is not considered when harvesting occurs (Cope and Punt 2009). By adopting as many stocks as are suggested by available information, even if that information is preliminary and based on small samples, co-managers reduce the risk of over-exploitation associated with considering smaller stocks to be part of a more numerous and wider-ranging stock, when in fact they are segregated for all or part of the year and have some annual site fidelity to specific areas. An example of the depletion of a local beluga stock is the Ungava Bay stock, which has been severely depleted, perhaps eradicated, by commercial whaling (Reeves and Mitchell 1989). The numbers of belugas using Ungava Bay in summer in the past few decades is not known precisely but is so low that few, if any, are seen during surveys (Finley *et al.* 1982; Smith and Hammill 1986; Kingsley 2000; Gosselin *et al.* 2009). As a result, summer hunting in Ungava Bay has been closed, with a few exceptions, since 2005 (DFO 2009).

STOCK DEFINITION OF NUNAVUT BELUGA STOCKS

Nunavut beluga stocks were identified by various authors over the years (Sergeant and Brodie 1969, Sergeant 1973, Finley *et al.* 1982; Richard *et al.* 1990) and their identity was based on the disjunct distribution of beluga summering aggregations. Evidence that belugas returned annually to the same aggregation areas ("site fidelity") was obtained when nine of 14 individually-marked animals seen in the Nastapoka estuary (Eastern Hudson Bay) in the summer of 1983 were resighted there the following summer (Caron and Smith 1990). During the summer, known individuals were repeatedly seen returning to the Nastapoka estuary after offshore visits (Caron and Smith 1990). More evidence of beluga annual site fidelity came from genetic and contaminant research (Helbig *et al.* 1990; Brennin *et al.* 1997; Brown Gladden *et al.* 1997, 1999; de March *et al.* 2002; de March *et al.* 2004), which showed that animals of both sexes with specific mitochondrial DNA (mtDNA) types were found in certain summering areas but not in others and that the measure of genetic distance between samples of beluga from different summering areas indicated that there was little exchange of individuals between them. Belugas from the Mackenzie Delta, Somerset Island, Cumberland Sound, the Nelson River, and Eastern Hudson Bay were also tracked over the summer, autumn and winter seasons. Tracked individuals from each summering aggregations did not overlap in distribution in either summer

or winter (Richard *et al.* 2001a, b; Richard and Stewart 2009; Smith 2008; Hammill, pers. comm.) and in some cases, neither in autumn or spring.

Appendix I lists the information used for stock definition of Nunavut beluga stocks. In summary, there is strong evidence from genetic, contaminant and tracking data to support the definition of the stocks of belugas in Nunavut. Local knowledge was useful input to the understanding of the seasonal occurrence of belugas in Nunavut waters but provided weak inference on their stock delineation. These summer aggregations of belugas are therefore considered separate stocks for the provision of advice on Total Allowable Harvest.

POPULATION IDENTITY OF BELUGAS HARVESTED BY IQALUIT AND KIMMIRUT

The stock(s) harvested by hunters from Iqaluit is not know for certain but is thought to be the Western-Northern-Southern (WNS) Hudson Bay beluga stock (Fig.1). The Western part of this population is identified by COSEWIC as the Western Hudson Bay beluga population. This stock is large (mean estimate of ~63,000 animals) and winters in Hudson and Davis straits. Belugas found in Frobisher Bay and hunted by Iqaluit residents in summer are thought to be strays from this large main stock which summers in Hudson Bay along the Kivalliq, Manitoba and Ontario coasts. It is plausible that a large stock ranges more widely than smaller ones. Most belugas caught around Kimmirut are taken in the autumn when the WNS Hudson Bay stock has moved into Hudson Strait (Smith 2008). They are similar genetically to those hunted in summer in Western and Northern Hudson Bay (de March and Postma 2003) and differentiate from those hunted in the High Arctic, West Greenland and Cumberland Sound (de March *et al.* 2002, de March *et al.* 2004). Finally, no tagged belugas from Cumberland Sound or eastern Hudson Bay have moved into Frobisher Bay or adjacent to Kimmirut (Richard and Stewart 2009; Mike Hammill, DFO, unpublished data), while several tagged belugas from the WNS stock (Nelson River) have been tracked close to Kimmirut in autumn and winter (Smith 2008).

STOCK DEFINITION OF NUNAVUT NARWHALS

Two stocks of narwhals were previously identified in Nunavut waters: the High Arctic stock (later referred to as the Baffin Bay stock by the JCNB and the Eastern High Arctic-Baffin Bay population by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)) and the Northern Hudson Bay stock (Strong 1988). There is some preliminary but equivocal evidence of genetic and contaminant differences that suggest the existence of more stocks of narwhals (de March *et al.* 2003; de March and Stern 2003) (Fig.2). The only stock of Nunavut narwhals which clearly differentiates by both methods from the other ones is the Northern Hudson Bay stock. There is also some tracking evidence of individual fidelity to summering areas between years and intra-year evidence that show that the individuals from different summering aggregations of narwhals do not mix during summer and, in the case of the Somerset stock, also not during autumn and winter. Figure 2 shows three stocks hypothesized by the JCNB, for which the only information is the occurrence of animals, either that they have been sighted in those areas (Parry Channel) or that they are hunted by Nunavut or Greenlandic hunters (Jones Sound, Smith Sound). Separate stocks were hypothesized for those areas given that, for other stocks, there is evidence of site fidelity and restricted geographic movements in summer (JCNB 2006) but there is no data to draw any clear statements on the distinctiveness of their range or genetic makeup.

Appendix II lists the information used for stock definition of Nunavut narwhals stocks. In summary, there is strong evidence from genetic, contaminant and tracking data to support the definition of the Northern Hudson Bay summering aggregation as a separate stock from other

narwhals in Nunavut. The evidence for defining other narwhal stocks is strongest from tracking data and weakest from genetics and contaminants. Although there are differences in the latter data, differences may be overshadowed by the fact that many landed animals are caught during seasons of migration, diluting differences between samples. Local knowledge was useful input to the understanding of the seasonal occurrence of narwhals in Nunavut waters but provided weak inference on their stock delineation. To reduce the chances of depletion of local stocks, the recommended precautionary approach is to also consider summer aggregations of narwhals as separate stocks for the provision of advice on Total Allowable Harvest.

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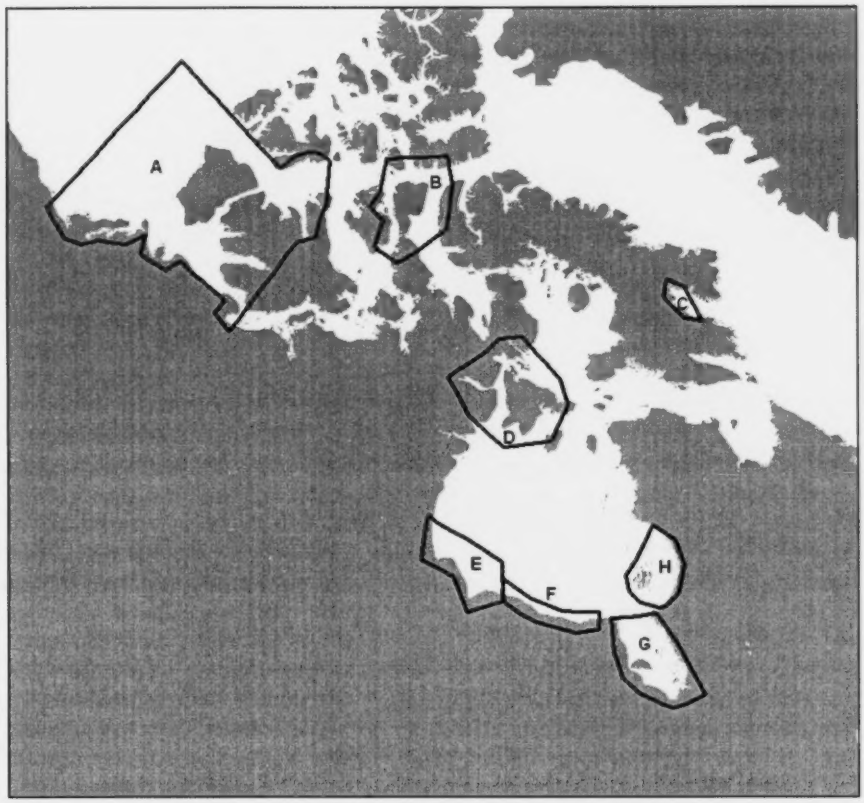

Fig. 1. Summer aggregation areas of Nunavut beluga whales (A: Eastern Beaufort Sea; B: Eastern High Arctic-Baffin Bay; C: Cumberland Sound; E-D-F: Western-Northern-Southern Hudson Bay (identified by COSEWIC as the Western Hudson Bay population); G: James Bay; H: Eastern Hudson Bay).

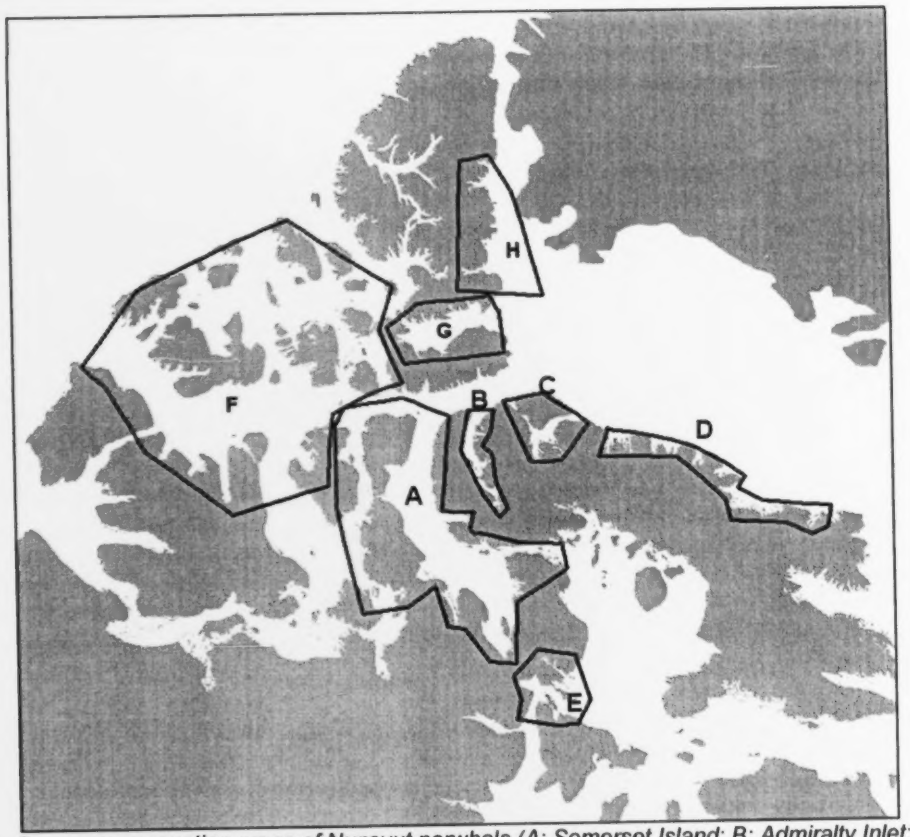

Fig. 2. Summer aggregation areas of Nunavut narwhals (A: Somerset Island; B: Admiralty Inlet; C: Eclipse Sound; D: East Baffin Island; E: Northern Hudson Bay; F: Parry Channel; G: Jones Sound; H: Smith Sound).

Appendix I: Information pertaining to stock definition of Nunavut beluga stocks

Western-Northern-Southern Hudson Bay Beluga stock (Identified by COSEWIC as Western Hudson Bay Beluga population)	
A) Seasonal range and aggregations based on local knowledge and reports	Repulse Bay, Churchill, Winisk, York Factory and Fort Severn residents report beluga occupying their area from May to September. Aggregation areas are in the estuaries of the Seal, Churchill, and Nelson rivers.
B) Appearance and behaviour	Belugas from Churchill and Arviat are on average smaller than the ones in Cumberland Sound, West Greenland, Somerset Island (Baffin Bay stock) and the Beaufort Sea but not different from those in Eastern Hudson Bay.
C) Genetics and contaminants	Churchill, Arviat, and Repulse Bay belugas differentiate genetically from those of Eastern Hudson Bay. Differences in concentrations of heavy metals were found between regions of the Arctic.
D) Seasonal range and aggregations based on tracking	Animals instrumented in July in the Churchill and Nelson river estuaries, MB, remained there at least until late-August or September. Tagged Nelson River estuary belugas migrated along the Kivalliq coast or offshore of islands along the Nunavik coast. All belugas tagged in WNS Hudson Bay wintered in Hudson Strait.
References	*A) Pers. comm. to author; Doan and Douglas 1953; Sergeant 1973; Richard et al. 1990; B) Sergeant and Brodie 1969, 1975; Doidge 1990; Stewart 1994; Heide-Jørgensen and Teilmann 1994; C) Brown Gladden et al. 1997, 1999; de March et al. 2002; de March and Postma 2003; Wagemann et al. 1990; Rosenberg 2003; D) Smith, 2008; P. Richard, DFO, unpubl. data.*
Eastern High Arctic - Baffin Bay Beluga stock	
A) Seasonal range and aggregations based on local knowledge and reports	Residents of Pond Inlet, Arctic Bay, Resolute Bay and Grise Fiord report spring movements west through Lancaster Sound, summer residence around Somerset Island and eastward return movement in the autumn. Belugas spend the winter in the North Water polynia of northern Baffin Bay.
B) Appearance and behaviour	Belugas from the High Arctic and west Greenland are on average larger than the ones in Hudson Bay.
C) Genetics and contaminants	Grise Fiord and West Greenland beluga mitochondrial DNA (mtDNA) samples differentiate genetically from those of Southeast Baffin Island. Differences in concentrations of heavy metals were found between regions of the Arctic.
D) Seasonal range and aggregations based on tracking	Animals tagged at the Cunningham Inlet and Elwin and Creswell bays were tracked into Peel Sound in late July – early August. They migrated east along the Devon Island coast in September and October. Many entered Jones Sound but wintered in the North Water polynia of northern Baffin Bay. A few moved to West Greenland for the winter. Two tagged belugas (one at Somerset Island in Aug.; on at Devon Island in Sept.) were resighted a year later near Somerset Island.

References	*A) Pers. comm. to author; Remnant and Thomas 1992; Stewart et al. 1995; B) Sergeant and Brodie 1969; Doidge 1990; Stewart 1994; Heide-Jørgensen and Teilmann 1994; C) de March et al. 2002; Wagemann et al. 1990; Rosenberg 2003; D) Smith and Martin 1994; Richard et al. 2001a; Heide-Jorgensen et al. 2003a; Orr et al. 1998.*
Cumberland Sound Beluga stock	
A) Seasonal range and aggregations based on local knowledge and reports	Residents of Pangnirtung report that belugas summer in and around Clearwater Fiord (Midlurialik) and range further into the west part of Cumberland Sound in autumn and spring. Belugas with distinct deformities have reportedly been seen for decades.
B) Appearance and behaviour	Pangnirtung hunters report that resident belugas are bigger in body size, have different maqtaq, and behave differently than other belugas sometimes found along the west coast of Cumberland Sound or at the flow edge in the spring.
C) Genetics and contaminants	Combined analysis of contaminants and genetics suggest that belugas hunted by Pangnirtung residents are not hunted in Iqaluit or Kimmirut. Differences in concentrations of heavy metals were found between regions of the Arctic.
D) Seasonal range and aggregations based on tracking	Belugas tagged near Clearwater Fiord followed similar patterns of seasonal movement to those described in (A). None left the Sound during the autumn. They wintered in a polynia at the northeast corner of the mouth of Cumberland Sound
References	*A) Pers. comm. to author; Kilabuk 1998 ; B) Pers. comm. to author; Kilabuk 1998; C) de March et al. 2004; Wagemann et al. 1990; Rosenberg 2003; D) Richard and Stewart 2009; P. Richard, DFO, unpubl. data.*
Eastern Beaufort Sea Beluga stock	
A) Seasonal range and aggregations based on local knowledge and reports	Kugluktuk hunters report occasional visits into Coronation Gulf from Dolphin and Union Strait by Eastern Beaufort Sea belugas.
B) Appearance and behaviour	
C) Genetics and contaminants	Eastern Beaufort Sea belugas show significant mtDNA genetic differences with belugas from Nunavut. Differences in concentrations of heavy metals were found between regions of the Arctic.
D) Seasonal range and aggregations based on tracking	Belugas of both sex tagged at the Mackenzie Delta in mid-July and early August, moved no further east than Amundsen Gulf or Viscount Melville Sound. In autumn, they migrated west into the Chukchi Sea, ending in the Bering Sea where they wintered.
References	*A) Lois Harwood, DFO Yellowknife, pers. comm.; C) Brown Gladden et al. 1997, 1999; Wagemann et al. 1990; Rosenberg 2003; D) Richard et al. 2001b; P. Richard, DFO, unpubl. Data.*

James Bay Beluga stock	
A) Seasonal range and aggregations based on local knowledge and reports	Belugas have been observed in James Bay in winter but they are seen by locals mainly in summer when they approach the coastline and enter river mouths.
B) Appearance and behaviour	
C) Genetics and contaminants	Preliminary results suggest that previously unknown genetic types occur in James Bay.
D) Seasonal range and aggregations based on tracking	Belugas tagged in summer in James Bay in both 2008 and 2009 have remained in the area well into December, showing no signs of migrating out of James Bay for the winter.
References	*A) Jonkel 1969; OMNR staff, pers. comm. to author; C) Lianne Postma, DFO, pers comm.; D) M. Hammill, DFO, pers. comm.*
Eastern Hudson Bay Beluga stock	
A) Seasonal range and aggregations based on local knowledge and reports	Nunavik hunters report that belugas in Hudson Strait in spring and early summer. Sanikiluaq hunters report that belugas usually arrive in late June, although some have occasionally been found in winter. In summer, hunters of both areas report that belugas are distributed throughout the Eastern Hudson Bay arc and around the Belcher Islands. Nunavik hunters observe belugas migrating east along the Nunavik Hudson Strait coast and into Ungava Bay in autumn.
B) Appearance and behaviour	Belugas from Eastern Hudson Bay are on average smaller than the ones in Cumberland Sound, West Greenland, Somerset Island (Baffin Bay stock) and the Beaufort Sea but not different from those in Western Hudson Bay.
C) Genetics and contaminants	Most belugas from Eastern Hudson Bay are differentiated genetically from belugas from all other stocks in Nunavut. They share genetic types with the St. Lawrence stock.
D) Seasonal range and aggregations based on tracking	Belugas tagged at the Little Whale and Nastapoka rivers remained in the Eastern Hudson Bay arc (including the Belcher Island waters) during summer. They migrated along the Nunavik coast to the Labrador Sea for the winter.
References	*A) Finley et al. 1982; Lewis et al. 2009; Pers. comm. to author; B) Doidge 1990; C) Brennin et al. 1997; Brown Gladden et al. 1997; de March and Postma 2003; D) Lewis et al. 2009; M. Hammill, DFO, pers. comm.*

Appendix II: Information pertaining to stock definition of Nunavut narwhal stocks

Somerset Island Narwhal stock	
A) Seasonal range and aggregations based on local knowledge and reports	Resolute hunters report seasonal occurrence of narwhals in Barrow Strait, Peel Sound and Prince Regent Inlet between spring and fall.
B) Appearance and behaviour	
C) Genetics and contaminants	Creswell Bay narwhal samples were genetically different from Repulse Bay and Pangnirtung samples.
D) Seasonal range and aggregations based on tracking	Animals tagged at Creswell Bay migrated through Lancaster Sound in October and November to reach mid-Baffin Bay for winter. Two returned to their Somerset Island summering area the following year. A third was resighted migrating through Lancaster Sound five years later.
References	*A) Pers. comm. to author; Remnant and Thomas 1992; C) de March et al. 2003; de March and Stern 2003; D) Heide-Jørgensen et al. 2003b, 2008.*
Admiralty Inlet Narwhal stock	
A) Seasonal range and aggregations based on local knowledge and reports	Arctic Bay hunters report seasonal occurrence of narwhals in or near Admiralty Inlet from May to December.
B) Appearance and behaviour	Some hunters reported observing two forms of narwhals: a larger one and a smaller one.
C) Genetics and contaminants	Arctic Bay narwhal samples were genetically different from Igloolik, Qikiqtarjuaq and Pangnirtung samples.
D) Seasonal range and aggregations based on tracking	Narwhals tagged in Admiralty Inlet migrated along Baffin Island to Davis Strait where they wintered. One returned to the mouth of Admiralty Inlet the following spring.
References	*A) Pers. comm. to author; Stewart et al. 1995; B) Remnant and Thomas 1992); C) de March et al. 2003; de March and Stern 2003; D) Dietz et al. 2008;*
Eclipse Sound Narwhal stock	
A) Seasonal range and aggregations based on local knowledge and reports	Pond Inlet hunters report seasonal occurrence of narwhals in or near Eclipse Sound area from spring to fall
B) Appearance and behaviour	Some hunters report differences in shape and colour of some narwhal observed.
C) Genetics and contaminants	
D) Seasonal range and aggregations based on tracking	Narwhals tagged in the Eclipse Sound area migrated along Baffin Island to Davis Strait where they wintered.
References	*A) personal communications to author; Remnant and Thomas 1992); B) Remnant and Thomas 1992; C) de March et al. 2003; D) Dietz et al. 2001; Heide-Jørgensen et al. 2002.*

East Baffin Island Narwhal stock	
A) Seasonal range and aggregations based on local knowledge and reports	Local hunters report seasonal occurrence of narwhals in East Baffin fiords and bays from spring to fall.
B) Appearance and behaviour	
C) Genetics and contaminants	Qikiqtarjuaq and Clyde River samples were genetically different from Repulse Bay, Arctic Bay, and Grise Fiord samples, and Qikiqtarjuaq samples from Pond Inlet samples. Contaminant differences were also found.
D) Seasonal range and aggregations based on tracking	N/A
References	*A) Pers. comm. to author; Remnant and Thomas 1992); B) Remnant and Thomas 1992; C) de March et al. 2003, de March and Stern 2003.*
Northern Hudson Bay Narwhal stock	
A) Seasonal range and aggregations based on local knowledge and reports	Local hunters report seasonal occurrence of narwhals in the Repulse Bay-Frozen Strait-Lyon Inlet area from spring to fall.
B) Appearance and behaviour	One hunter reported a larger darker form with a longer tusk than lighter-coloured narwhals but most hunters did not see noticeable differences.
C) Genetics and contaminants	Repulse Bay samples were genetically different from all the others. Contaminant samples were also different from narwhals from several other communities.
D) Seasonal range and aggregations based on tracking	Narwhals tagged in Lyon Inlet and Repulse Bay migrated through Foxe Channel and Hudson Strait in November and December to Davis Strait where they wintered. Two returned west through Hudson Strait the following spring.
References	*A) personal communications to author, Gonzalez 2001, Westdal 2008; B) Gonzalez 2001, C) de March et al. 2003; de March and Stern 2003; D) Westdal 2008.*